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A COMPUTER MODEL FOR SELECTING
COMMON STOCK PORTFOLIOS

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College of Commerce and Business Administration
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A COMPUTER MODEL FOR SELECTING COMMON STOCK PORTFOLIOS

The selection of common stocks for inclusion into portfolios is traditionally accomplished by first analyzing several types of financial data about a set of companies followed by a subjective judgment concerning the investment potential of the various securities under review. In view of the increasing accessibility of computer services and financial data bases, more attention should be given to incorporating objective criteria into investment decision-making instead of limiting the decisions to purely subjective considerations. Quantitative investment models based upon computer analysis can be used both to complement subjective decision-making as well as to test the efficacy of various quantifiable, subjective decision criteria.

The purpose of this paper is to describe and present the empirical results of an objective common stock portfolio selection model which is based upon (1) earnings-per-share (EPS) growth rates and (2) price-to-earnings (PE) ratios. The common stock selection model demonstrated in this paper shows the potential associated with using the distributions of historical EPS growth rates and PE ratios for making objective investment decisions based upon computer screening over a large sample of companies to identify common stocks with desirable investment characteristics.

The empirical results obtained from applying the model to a sample of companies from the Compustat Annual Industrial Tape show that the model has considerable potential for achieving its objective of selecting undervalued securities. For the 1960-73 test period used in the study, the twenty-security portfolios selected by the most conservative form of the model

had an annual arithmetic mean return of .187 compared to the S & P 500 Index return of .076 for the same period. When consideration was given for differences in risk, the portfolios selected by the model were still superior to the S & P 500.

Theoretical Foundations of the Model

The common stock selection model described in this paper is based upon selecting portfolios of securities which at the time of selection are, on the average, undervalued. The two primary variables used in the model are a company's historical EPS growth rate and PE ratio. The distributions of these variables, as determined by past data, are of particular interest in the study. Each firm's past EPS growth rate distribution is used for the initial screening of companies, while the historical PE ratio distribution for each firm is subsequently employed to determine a ratio of the "lowest probable PE ratio" to the "current PE ratio" for each company passing the screens described below. This ratio, called the LC ratio, is used as an index of a stock's current investment potential. A larger LC ratio indicates a lower current PE compared to the company's risk-adjusted historical average PE ratio based upon a calculated "lower confidence limit PE ratio."

The following example will be helpful in describing the concept of a lower confidence limit PE ratio. For illustrative purposes, we will assume a particular firm had an average PE ratio of 12 for the past four years with a standard deviation of 4. If the distribution of the PE is normal, the probability of the actual PE falling below a value of 8, or, in other words, one standard deviation below the mean would be approximately .16, and the probability of the actual PE ratio falling to a value of 4, or two

standard deviations below the mean, is, approximately .025. This example is shown graphically in Figure I below.

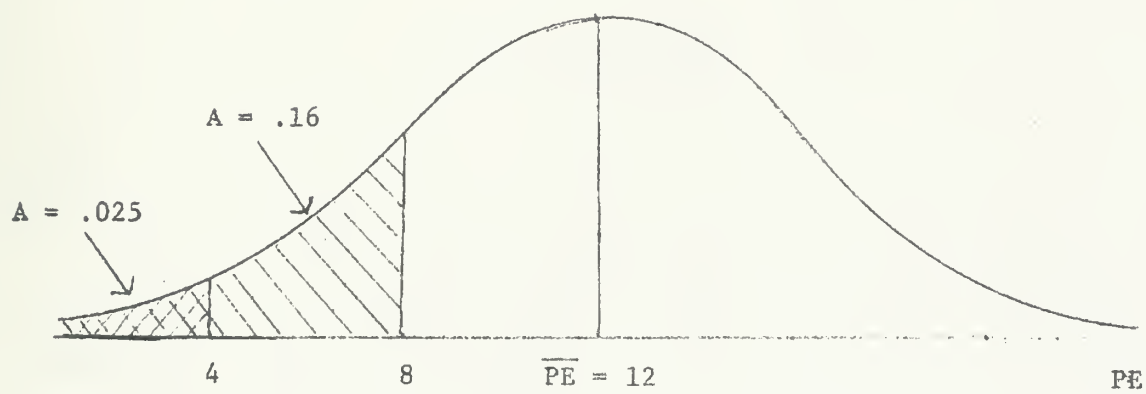
 Figure I About Here

According to the example provided in Figure I, the probability that the PE ratio will be at least 8 is .84 and at least 4 is .975.¹ This framework is used to determine "lower-confidence-limit" estimates for a firm's PE ratio by varying the number of standard deviations below the mean, referred to as the "PE risk-adjustment coefficient" (PERAC), to determine the respective probability of having a PE ratio at least as large as the lower confidence limit PE. This illustration is, of course, based upon the assumption of normality as well as the assumption that distributions of PE ratios for individual companies are stationary over time. While these assumptions do not hold strictly for individual companies, they may be reasonable for groups of companies when combined together to form portfolios. The present study is not concerned with a test of the assumptions of the model, but instead, it is primarily concerned with the empirical results obtained from its application.

The distribution of a company's EPS growth rate is also used in the model to eliminate from investment consideration companies whose standard deviations of EPS growth rates are too high compared to their mean EPS growth rates.² The coefficient of variation (CV), defined as the ratio of the standard deviation to the mean of a random variable, provides a comparison of the standard deviation of the EPS growth rate with the average EPS growth rate as measured by the annual percentage changes in a company's reported EPS. Initially, all companies with negative coefficients

Figure I

A Hypothetical PE Ratio
Distribution: $\overline{PE} = 12$, $\sigma_{PE} = 4$



of variation are eliminated from investment consideration in a particular year, while coefficient of variation screens of 1, 2, and 3 are then used in a sensitivity analysis framework in the model to eliminate those companies whose coefficients of variation of EPS growth rates are positive, but less than 1, 2, or 3, respectively. The constraint that the computed CV value must be positive screens out all companies with declining EPS growth rates. The remaining companies must then have standard deviations about their average percentage changes in the annual EPS which are less than 1, 2, or 3 times the size of the company's EPS growth rate. The number of companies passing the CV screens for each "ex ante" screening period and each "ex post" evaluation period are given in Table 1.³

Table I About Here

Data

The data for the common stock evaluations used in demonstrating the model came from the Compustat Annual Industrial Tape for the years 1954 through 1973. Since the Compustat Tape includes New York Stock Exchange (NYSE) and American Stock Exchange (ASE) stocks as well as Over-the-Counter (OTC) stocks, a screen was used to eliminate all ASE and OTC stocks in order to have a sample of stocks which is more comparable to the S & P 500 Index for later market return comparisons. Screens for company size and fiscal year-ends were also applied. These screens eliminated from the study companies whose market value of outstanding common stock was less than \$100 million or whose fiscal year did not end in December. The purpose of the minimum equity valuation screen was to exclude smaller companies which would seldom be included in large portfolios, while the December fiscal year-end requirement was used to ensure that each company's EPS, PE ratio, and return used for

TABLE I

The Number of Companies Passing the CV Screens
for Each Ex Ante and Ex Post Period

<u>Ex Ante Period</u>	<u>Ex Post Period</u>	<u>Number of Companies</u>		
		CV = 1	CV = 2	CV = 3
1954-1958	1959	52	121	173
1955-1959	1960	59	123	180
1956-1960	1961	45	92	129
1957-1961	1962	52	108	141
1958-1962	1963	85	160	211
1959-1963	1964	84	143	172
1960-1964	1965	199	308	367
1961-1965	1966	291	394	425
1962-1966	1967	312	410	437
1963-1967	1968	233	348	385
1964-1968	1969	172	270	330
1965-1969	1970	138	231	266
1966-1970	1971	96	154	185
1967-1971	1972	92	171	220
1968-1972	1973	111	202	270

comparative rankings in the analysis were all for the same time period. A final screen used in the analysis was to eliminate from investment consideration in a particular year, companies which had one or more years of negative earnings in the "ex ante period" preceding the particular investment year. The rationale for this screen was twofold. First, this strategy should eliminate companies with riskier earnings patterns. Second, it is difficult to calculate an EPS growth rate during a time interval in which some negative values occur.

The variables used in the calculations to determine the most desirable common stocks were the average EPS growth rate during a specified number of prior years called the ex ante period, the standard deviation of the EPS growth rate, the current PE ratio, the average PE ratio, and the range of the PE ratio values during the ex ante period. The length of the ex ante period used in this study was four years, and the screening and ranking procedure used in the analysis produced 14 annual investment decisions and 14 annual ex post returns to demonstrate the model.⁴

Summary of the Model's Basic Steps

The basic steps of the procedure for the annual selection of securities for inclusion into portfolios are summarized below:

1. Companies were screened for: a minimum market value of common stock equity, NYSE listing, December fiscal year-end, and non-negative EPS during each of the sets of four ex ante years preceding each investment decision year.
2. The ex ante EPS growth rate as an average percentage change in EPS and the standard deviation about the average change were computed for each company satisfying the requirements in (1.) above.

3. The EPS growth rate and standard deviation for each company were used to compute a "coefficient of variation" defined as the ratio of the standard deviation of the EPS growth rate to the average EPS growth rate.
4. Companies whose EPS coefficients of variation in a given ex ante period were negative or were greater than specified values of the coefficient of variation screen were eliminated from investment consideration in a particular year, due to the instability of their reported earnings in comparison to their average EPS growth rates.
5. Following the screening of the company samples on the basis of the coefficient of variation of their EPS growth rate, a ratio of the "lowest probable PE ratio" to the "current PE ratio" (LC ratio) was calculated for each company, and companies were ranked in descending order according to their computed LC values.⁵ The LC for each company used in making selection decisions for each of the 14 ex post investment periods was calculated as given below:

$$LC = \frac{\overline{PE} - (PERAC) (\sigma_{PE})}{P / [(EPS) (1 + \bar{g}_{EPS})]}$$

where

$\overline{PE}$ = the mean of the midpoints between the high and low PE ratio for each year,

PERAC = the PE risk-adjustment coefficient,

σ_{PE} = the range of the ex ante PE ratios divided by 6,⁶

P = the current (end of period) price per share for the investment decision year,

EPS = the annual earnings per share for the current year ending December 31, and

$\bar{g}_{EPS}$ = the average annual percentage change in EPS for the ex ante period.

6. Following the ranking of the companies passing the previously mentioned screens, the top 20 companies, i.e., those with the highest 20 LC values were selected for inclusion into the portfolio for a one-year period. At the end of the year the complete analysis was performed again for the next "ex ante" period.
7. The final step in the analysis was to compare the performance of the LC portfolios with the "Compustat basic sample" portfolio, defined as the entire set of companies passing the initial screens and eligible to be screened by the CV criteria. In addition, the LC portfolios were also compared with the performance of the Standard and Poor's 500 Composite Index.

The rationale behind ranking companies on their computed LC values is to identify companies which have PE ratios below their historical or average PE ratios. This procedure facilitates the selection of companies whose PE ratios are more likely to rise than to fall. That is, having screened out companies with highly volatile earnings, the change in the PE ratio is expected to occur more as a result of a change in the company's price in its EPS. Thus, companies with higher LC values should outperform market averages as well as companies with lower LC values.

Sensitivity Analysis

A sensitivity analysis technique was used to determine the optimal coefficient of variation (CV) screen and the optimal PE risk-adjustment coefficient (PERAC) values.⁷ The CV values used were 1, 2, and 3, while the PERAC values used were 0, .5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, and 4.0. In all, a set of 27 unique pairs of CV and PERAC parameters was used. Initially,

the portfolio results for all pairs of parameters were calculated for the complete set of ex post test periods to determine the optimal pair of parameters to be used over the 14 year evaluation period. However, since this technique can be criticized as unrealistic for a practical application because of its use of ex post information in making ex ante decisions,⁸ a second procedure was also used, whereby the optimal parameters for a given ex ante period were determined and then used to calculate the LC values for the next successive ex ante period to determine a new pair of optimal CV-PERAC parameters for the following period. This modification of the basic procedure increased considerably the credibility of the technique. The portfolios which were selected without the modification are called "ex post" portfolios, while those portfolios selected by incorporating the modification are referred to as the "ex ante" portfolios.

In order to enhance further the model's credibility, an additional modification was incorporated whereby the EPS values for a "current year" ending December 31 were not used in making the "current decision." Instead, the same basic technique described above was followed, except the EPS values used in determining the "current PE ratios" in a particular year were those for the immediately prior year, thus using "lagged" EPS values. This modification of the model did, of course, lower its performance, but not substantially. The empirical results of the original (non-lagged) "ex post" and "ex ante" as well as the results for the lagged models are reported for comparative purposes.

Application of the Model

The first five years of data (1954-1958) for the basic sample were used to screen over the company set and to calculate the variables used in the

model for the companies passing the initial screens in the first ex ante period. The companies passing the CV screen values were then ranked on their computed LC values for each CV-PERAC pair, and the 20 companies with the largest LC values for each of the 27 pairs of parameters were selected for inclusion into "ex post" equally-weighted portfolios of 20 common stocks for the one year ex post period immediately following the ex ante period, the first ex post period being 1959. The actual 1959 portfolio returns were then calculated for each of the 27 pairs of CV-PERAC values and saved in the program until the final ex post portfolio returns for all periods, including 1973, were calculated; the 27 portfolio results for each of the preceding years were then printed out.

Following the calculations for the first ex ante period, the basic sample of companies for the second ex ante period (1955-1959) was then determined, and the resulting ex post (1960) 20-security portfolios were selected and their returns calculated and saved. The entire procedure for determining the basic sample was completed for 15 separate, consecutively updated periods. Then the optimal set of CV and PERAC parameters was selected on the basis of the returns of the 27 annual ex post portfolios. However, as indicated earlier, this technique is subject to the criticism that the selection of the optimal risk-adjustment parameters is on an ex post basis using the ex post information. Therefore, to eliminate this potential weakness, the modification described above was incorporated, whereby the "best" pair of CV-PERAC parameters was selected to be used for the 1960 investment decision based upon the pair's associated return performance in 1959, i.e., the CV-PERAC pair selecting the 20 securities with the highest of the 27 portfolio returns in 1959 was used to select the 20 securities for the 1960 portfolio. The portfolios selected according to

this technique are referred to as the "ex ante LC portfolios," while those based upon the ex post selection of the optimal pair of CVS-PERAC values are called the "ex post LC portfolios." In order to have comparable time periods for comparing the "ex ante LC portfolios" with the "ex post LC portfolios," the "ex post LC portfolio" results are reported for the 1960-1973 period instead of for the available 1959-1973 period.

The reporting of the results is further divided into "lagged" and "non-lagged" portfolios, with respect to the EPS value used in the determination of the "current PE ratio," to show the effects of calculating the current PE ratio with a "current" December 31 stock price, but using the prior year's EPS figure which would have been reported at least 9 or 10 months before the "current" investment decision at the end of the ex ante period. The non-lagged LC portfolios' current PE ratios were calculated using the December 31 closing stock price as well as the EPS for the same year ended December 31. Although it may be somewhat unrealistic to assume immediate knowledge of the annual EPS value, three of the quarterly earnings reports would have been available by the end of the year, and many, reasonably accurate estimates for the final quarter are usually available by the end of the fourth quarter.

Empirical Results

The annual portfolio results for: (1) the "ex ante LC portfolios" and the "ex post LC portfolios" without the EPS lag and with the EPS lag, (2) the "Compustat basic sample" of companies passing the screens for exchange listing, fiscal year-end, market value of outstanding common stock, and non-negative EPS values, and (3) the Standard and Poor's Composite Index of 500 common stocks are given in Table II. In addition to reporting the annual returns for each portfolio for each year, the

arithmetic mean return (AMR), geometric mean return (GMR), and standard deviation (SD) of the arithmetic mean return are also given for each portfolio selection technique in the lower portion of the table.

Table II About Here

In order to show graphically the relationship of the "non-lagged, ex ante LC portfolio" returns with the returns from the Standard and Poor's Composite Index of 500 stocks for the 1960-1973 period, the returns for the two are plotted in Figure II for each year. The non-lagged, ex ante LC portfolio returns were superior in 11 out of the 14 investment periods, and only slightly below the S & P 500 returns in the other three periods.

Figure II About Here

A comparison of the arithmetic mean returns for the non-lagged and lagged ex post LC portfolios for different values of the CV and PERAC parameters was then performed by averaging over the arithmetic mean returns for each of the respective CV and PERAC values. The results of these comparisons are given in Figures III and IV. An examination of Figure III reveals that the average returns associated with the "ex post LC portfolios" for the 9 pairs of CV-PERAC values for the "lagged" and "non-lagged" EPS values containing the CV values 1, 2, and 3, respectively, are relatively insensitive to changes in the CV parameter. However, as shown by Figure IV, the average returns for the "ex post LC portfolios" for the 3 pairs of CV-PERAC parameters containing the PERAC values 1.0, 1.5, and 2.0 for both the lagged and the non-lagged portfolios seem to be superior to the returns associated with PERAC values above 2.0. The mean, optimal CV values for the

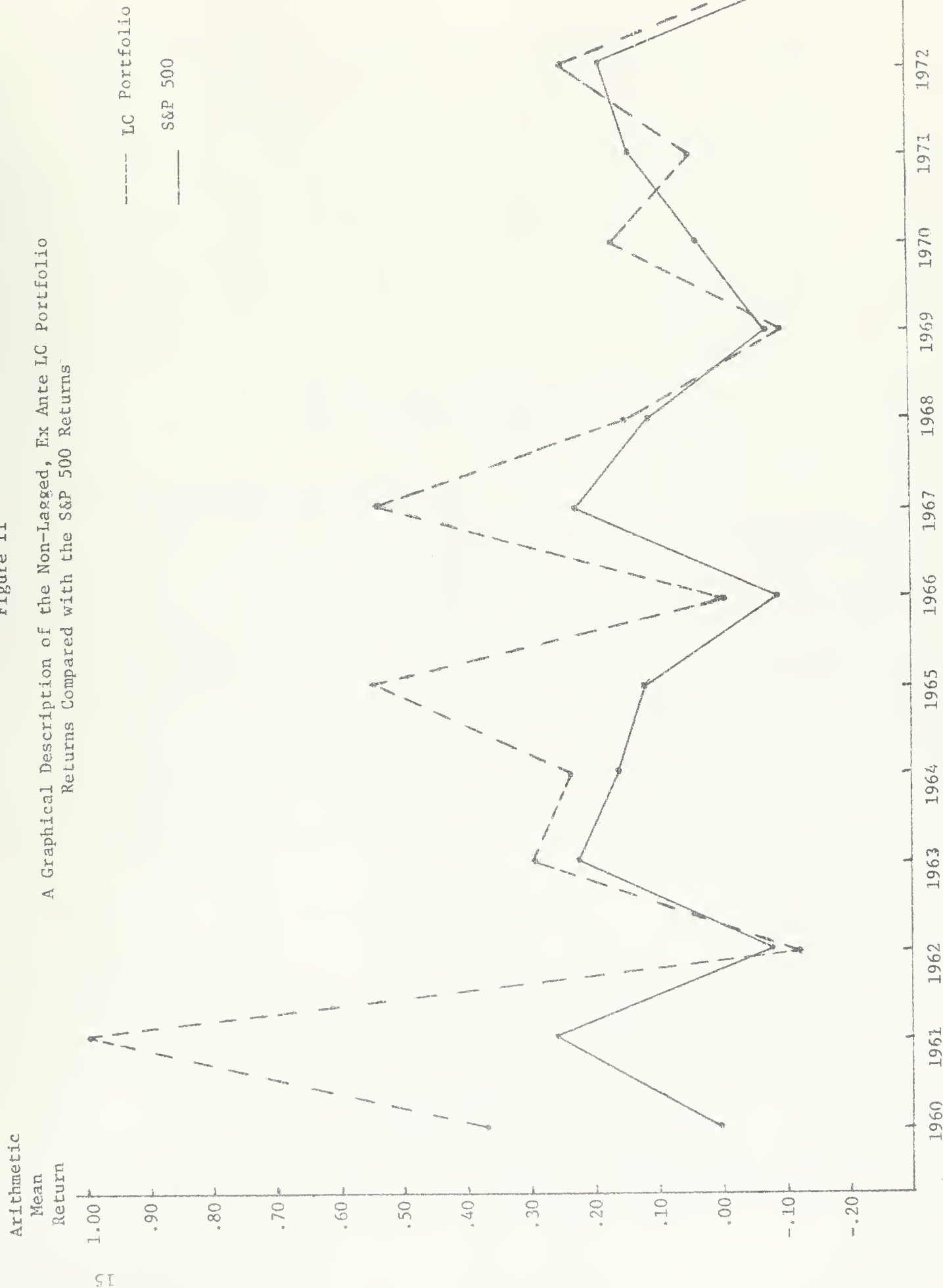
Table II

Annual Returns for the Non-Lagged and Lagged EPS
 Ex Ante and Ex Post LC Portfolios,
 the Compustat Basic Sample Portfolio,
 and the Standard and Poor 500 Index

Year	Non-Lagged Ex Ante LC Portfolios	Non-Lagged Ex Post LC Portfolios	Lagged Ex Ante LC Portfolios	Lagged Ex Post LC Portfolios	Compustat Basic Sample Portfolio	S&P 500 Returns
1960	.347	.372	.159	.318	.020	.005
1961	.959	.959	.986	.986	.308	.261
1962	-.132	-.164	-.166	-.166	-.133	-.084
1963	.288	.385	.227	.252	.220	.221
1964	.232	.124	.244	.091	.189	.160
1965	.543	.435	.505	.411	.258	.121
1966	-.002	.022	-.047	-.109	-.062	-.097
1967	.541	.550	.639	.474	.356	.233
1968	.157	.114	.199	.105	.217	.107
1969	-.097	-.156	-.140	-.106	-.167	-.081
1970	.171	.093	.154	.094	.021	.039
1971	.047	.183	.058	.197	.166	.139
1972	.243	.138	.148	.122	.110	.185
1973	-.103	-.151	-.138	-.053	-.153	-.143
AMR	.228	.206	.202	.187	.096	.076
GMR	.196	.173	.166	.156	.083	.068
SD	.291	.300	.311	.290	.170	.131

Figure II

A Graphical Description of the Non-Lagged, Ex Ante LC Portfolio
Returns Compared with the S&P 500 Returns



"ex ante LC lagged" and the "ex ante LC non-lagged" portfolios averaged over the 14 investment periods were 2.14 and 1.79, respectively, while the mean, optimal PERAC values for the "ex ante LC lagged" and the "ex ante LC non-lagged" portfolios were 1.21 and 1.75, respectively. The optimal CV and PERAC parameters for the lagged ex post LC portfolios reported in Table II were 1.0 and 1.0, respectively, while the optimal CV and PERAC parameters for the non-lagged ex post LC portfolios were also 1.0 and 1.0, respectively.

 Figures III and IV About Here

Risk-Adjusted Performance Evaluations

In order to compare the risk-adjusted performance of the LC portfolios with the "Compustat basic sample" and with the Standard and Poor's 500 Index, the ex post portfolio performance measures used previously by Sharpe [2], Treynor [3], and Jensen [1] were utilized. In all of the performance comparisons, the S & P 500 was used as the "market portfolio" and the annualized 90-day Treasury Bill yield was used as the risk-free rate of return. The ex post performance measure, denoted the "reward-to-variability" ratio used earlier by Sharpe, is represented below in Equation (2):

$$(2) \quad RVAR = \frac{\bar{R}_p - \bar{R}_f}{\sigma_p}$$

where

$\bar{R}_p$ = the arithmetic mean return on the portfolio,

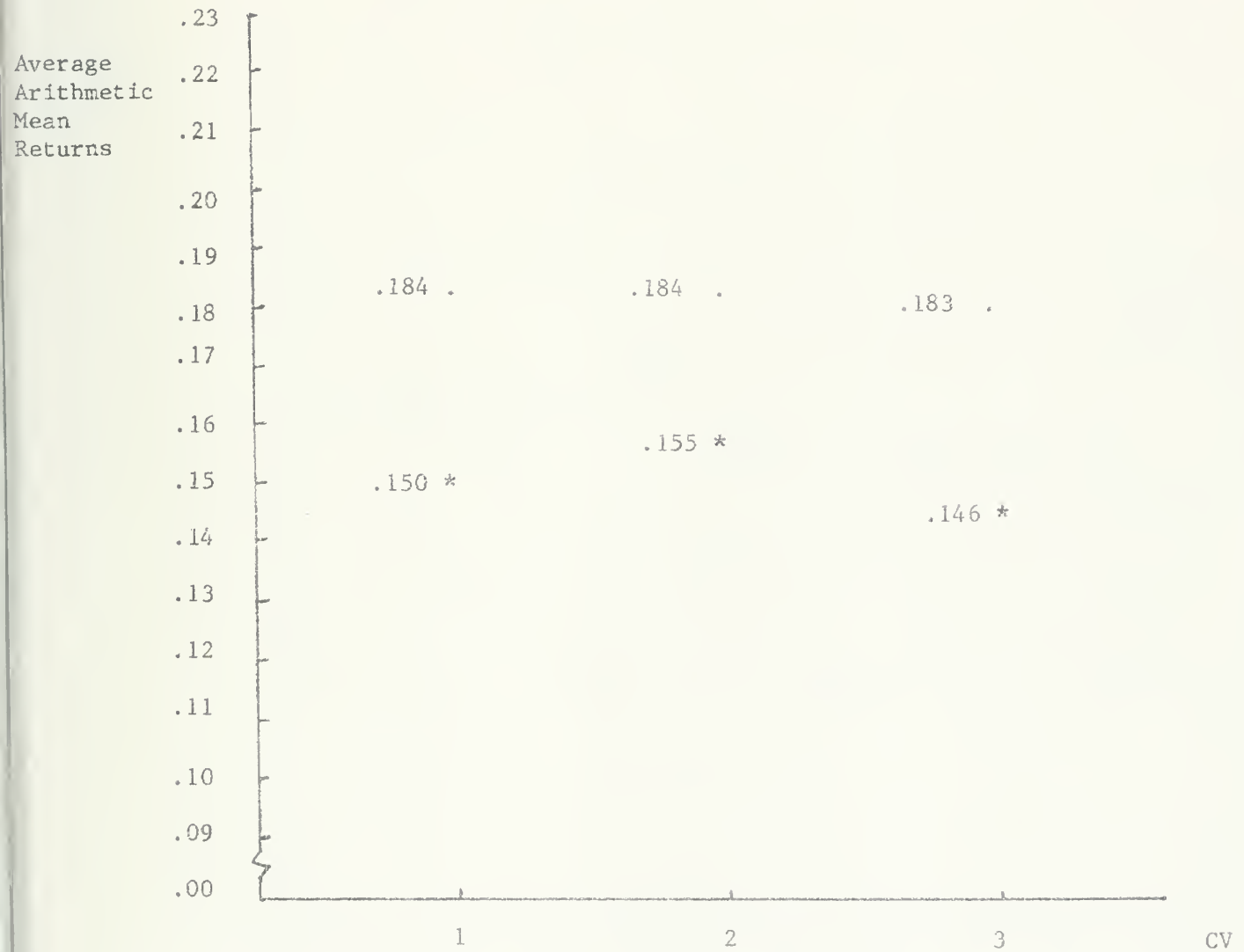
$\bar{R}_f$ = the average risk-free rate, and

σ_p = the standard deviation of the portfolio return.

In order to depict the RVAR values graphically, the portfolio means and standard deviations are plotted in Figure V in a mean-standard deviation

Figure III

The Average Arithmetic Mean Returns for
Non-Lagged and Lagged LC Portfolios
for CV = 1, 2, and 3.

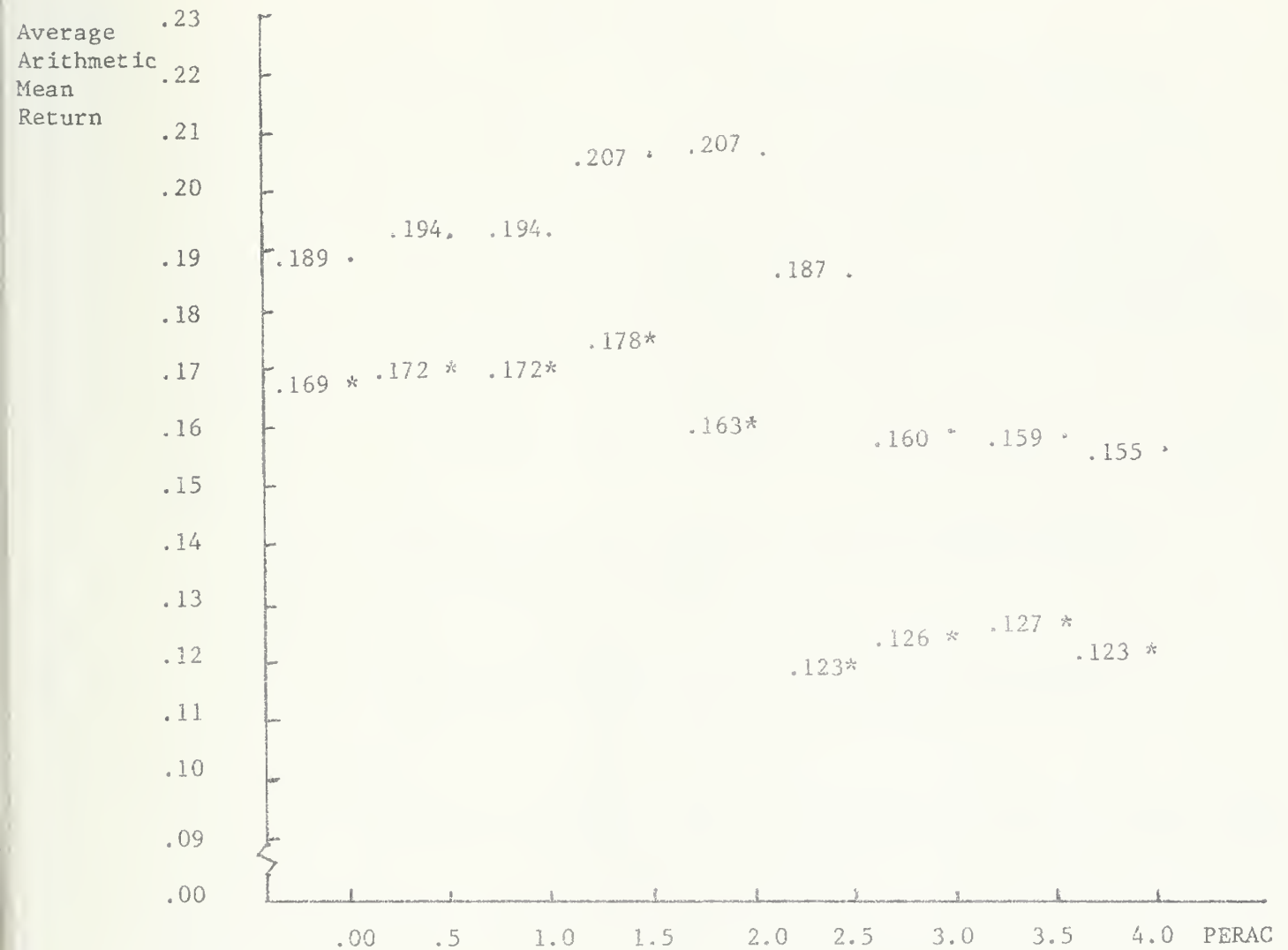


. Average Non-Lagged Ex Post LC Portfolio Returns.

* Average Lagged Ex Post LC Portfolio Returns.

Figure IV

The Average Arithmetic Mean Returns for
Non-Lagged and Lagged Ex Post LC Portfolios for
PERAC Values 0, .5, 1.0, ... 4.0.



. Non-Lagged Ex Post LC Portfolio Returns.

* Lagged Ex Post LC Portfolio Returns.

framework using the RVAR line for the S & P 500 as the benchmark for the comparisons of the LC portfolios and the Compustat basic sample portfolio. The average, annualized 90-day Treasury Bill yield for the 1960-1973 period was .044 and is used as the intercept in Figure V. An examination of Figure V shows that all of the LC portfolios were superior to the Compustat basic sample portfolio and to the Standard and Poor's 500 Index.

Figure V About Here

The Treynor framework for ex post portfolio performance comparisons, denoted the "reward-to-volatility" ratio, was used to compare the performance of the portfolios on the basis of their respective excess returns above the risk-free rate compared to their systematic risk level. The Jensen ex post portfolio measures (α_p) were obtained in the determination of each portfolio's systematic risk level (β_p) by using Equation (3) below:

$$(3) \quad (R_{pt} - R_{ft}) = \alpha_p + \beta_p (R_{mt} - R_{ft}) + e_{pt}$$

where

R_{pt} = the rate of return on the portfolio in period (year) t ,

R_{ft} = the risk-free rate in period t ,

α_p = the regression equation intercept term for the portfolio representing the Jensen ex post performance measure,

β_p = the systematic risk level of the portfolio,

R_{mt} = the rate of return on the market portfolio, where the S & P 500 return is used as a proxy for the market return, and

e_{pt} = the error term for the regression equation in period t .

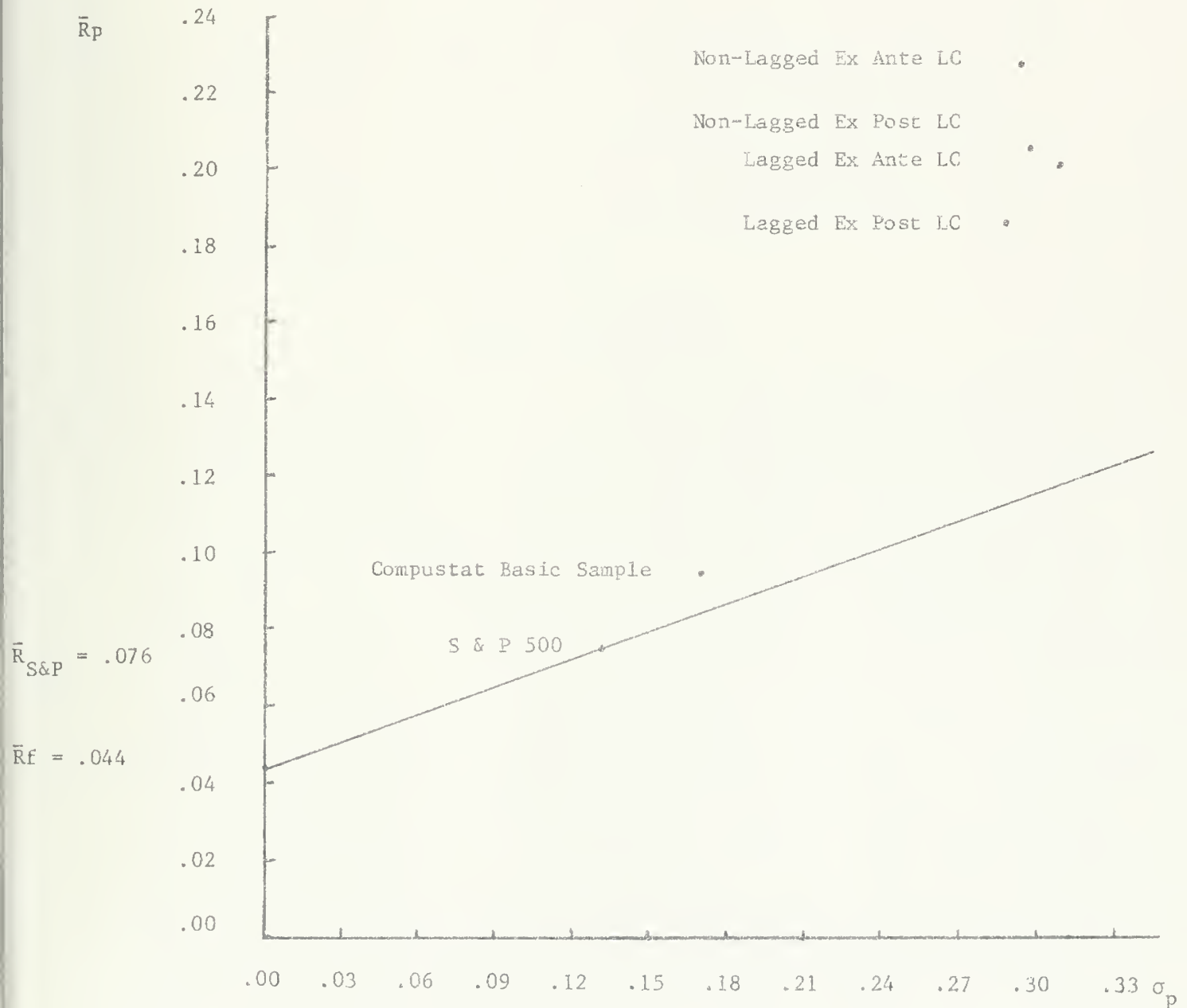
The computation of the Treynor "reward-to-volatility" ratio using the β_p from Equation (3) is shown below in Equation (4):

$$(4) \quad RVOL = \frac{\bar{R}_p - \bar{R}_f}{\beta_p}$$

where $\bar{R}_p$, and $\bar{R}_f$, and β_p are as previously defined.

Figure V

Sharpe "Reward-to-Variability" Comparisons
of the Ex Post Performance of the LC Portfolios, the
Compustat Basic Sample Portfolio, and the S & P 500.



A graphical representation of the RVOL for each of the LC portfolios and the Compustat portfolio, using the RVOL ratio for the Standard and Poor's 500 as a benchmark, is shown in a mean-beta framework in Figure VI. An examination of Figure VI indicates that on the basis of the Treynor RVOL values, all of the LC portfolios were superior to the Compustat portfolio and to the S & P 500. The vertical return differences between the plotted values for each of the portfolios and the RVOL line for the S & P 500 represents the "Jensen alpha" ex post performance measure. Since the point for each of the LC portfolios falls above the S & P 500 RVOL line in Figure VI, the LC portfolios also outperformed the S & P 500 on the basis of the Jensen alpha.

Figure VI About Here

In order to examine the diversification level of each of the portfolios, the coefficient of determination (R^2) associated with the regression equation for each of the portfolios was also recorded. These results as the arithmetic mean return, geometric mean return, standard deviation, beta, RVAR, RVOL, and Jensen α are summarized in Table III. The relatively low R^2 values of the LC portfolios indicate that the RVAR risk-adjusted performance measures may be more appropriate than the RVOL or Jensen α values for 20-security portfolios since the RVAR ratio considers the total risk (variability) of a portfolio, while the RVOL and Jensen α values only consider the systematic risk of a portfolio. It is, however, of interest to note that the RVAR values for the LC portfolios are at least double the RVAR for the S & P 500 and at least 60 percent above the highly diversified Compustat portfolio. Also, the 20-security LC portfolios' RVOL and Jensen α values are considerably above those of both the Compustat basic sample portfolio and the S & P 500.

Figure VI

Treynor "Reward-to-Volatility Comparisons
of the Ex Post Performance of the LC Portfolios,
the Compustat Basic Sample Portfolio, and the
S&P 500.

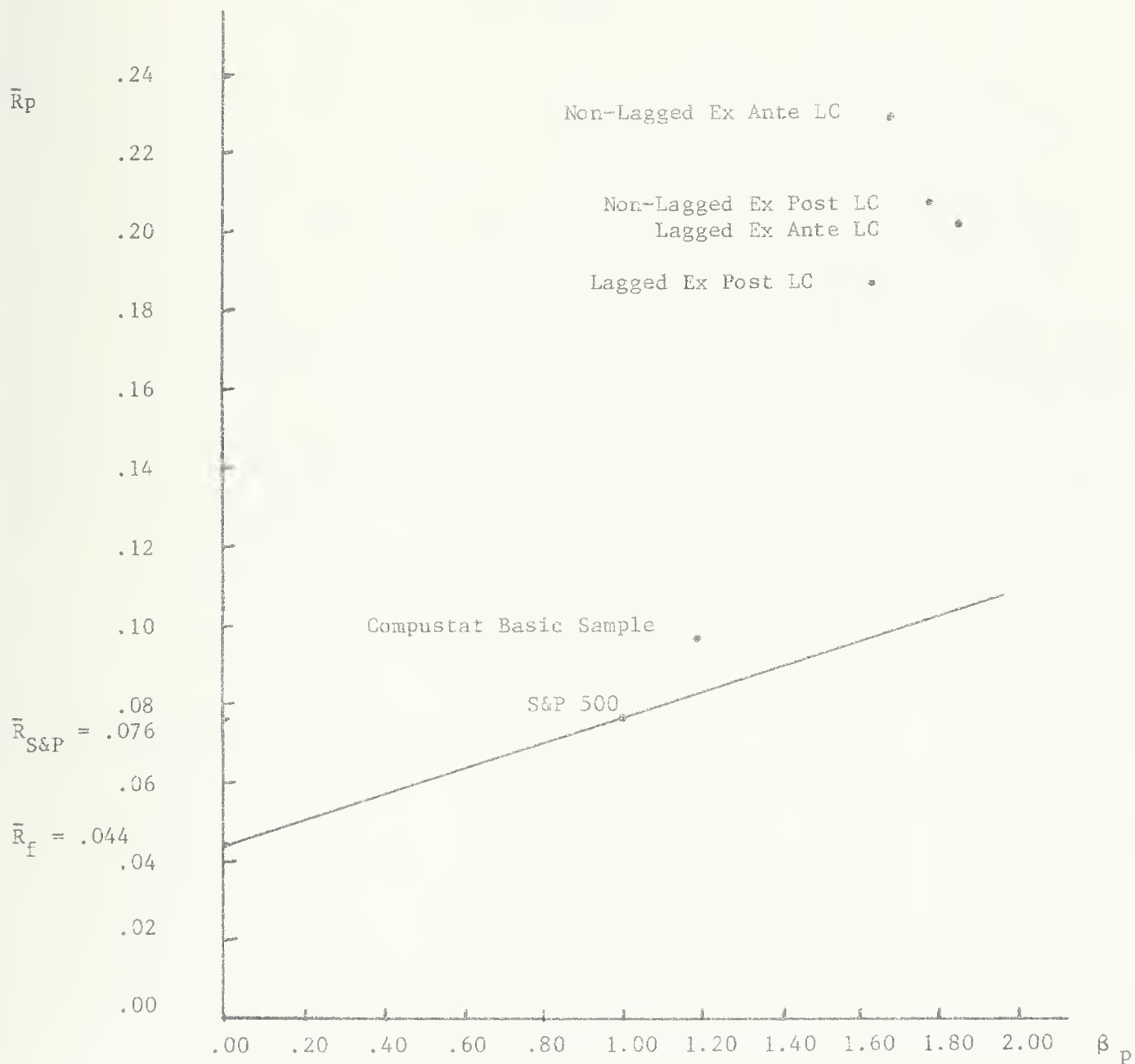


Table III About Here

An examination of the R^2 values in Table V reveals that, as expected, the LC portfolios are less highly diversified than the Compustat portfolio. The inclusion of more securities would of course increase the R^2 and thus provide more highly diversified portfolios. An increase in the number of securities would, however, be expected to decrease the effectiveness of the model since securities with lower LC values, which are less desirable for investment purposes, would be included, thus lowering the expected performance on the LC portfolios. In order to show the effects of using more securities in the portfolios, 40-security LC portfolios were also constructed using the same methodology with the exception of selecting the securities having the 40 highest LC values. The summary results for the 40-security portfolios are shown in Table IV. While the performance of the 40-security portfolios was, as expected, lower than the performance of the 20-security portfolios, the difference is rather small.

Table IV About Here

Conclusion and Implications

This paper has demonstrated the feasibility of applying objective, a priori determined common stock selection criteria to a large sample of companies for the identification of desirable companies for inclusion into common stock portfolios. These objectively constructed portfolios were able to out-perform both the Compustat basic sample and the S & P 500 Index. The empirical results obtained from the model developed in this paper and applied to financial data for a large sample of companies suggest the practicality as well as the profitability of developing and using

Table III

Summary of Risk-Return Measures for the 20-Security LC Portfolios
the Compustat Basic Sample Portfolio, and the S&P 500

Risk-Return Measure	Non-Lagged Ex Ante LC Portfolio	Non-Lagged Ex Post LC Portfolio	Lagged Ex Ante LC Portfolio	Lagged Ex Post LC Portfolio	Compustat Basic Sample Portfolio	S&P 500
Arithmetic Mean Return	.228	.206	.202	.187	.096	.076
Geometric Mean Return	.196	.173	.166	.156	.083	.068
Standard Deviation	.296	.300	.311	.290	.170	.131
Beta	1.694	1.780	1.851	1.636	1.195	1.000
R ²	.620	.644	.653	.584	.884	1.000
RVAR	.632	.545	.507	.493	.309	.245
RVOL	.109	.092	.085	.087	.044	.032
Jensen α	.130	.106	.099	.091	.014	.000

Table IV

Summary of Risk-Return Measures for the 40-Security LC Portfolios,
the Compustat Basic Sample Portfolio, and the S&P 500.

Risk-Return Measure	Non-Lagged Ex Ante LC Portfolio	Non-Lagged Ex Post LC Portfolio	Lagged Ex Ante LC Portfolio	Lagged Ex Post LC Portfolio	Compustat Basic Sample Portfolio	S&P 500
Arithmetic Mean Return	.170	.197	.148	.165	.096	.076
Geometric Mean Return	.151	.175	.128	.139	.083	.068
Standard Deviation	.216	.236	.217	.247	.170	.131
Beta	1.393	1.434	1.340	1.598	1.195	1.000
R ²	.752	.669	.693	.764	.884	1.000
RVAR	.584	.649	.482	.489	.309	.245
RVOL	.090	.107	.078	.075	.044	.032
Jensen α	.081	.107	.062	.069	.014	.000

computer screening and selection techniques for making common stock investment decisions.

Although the empirical results reported in this paper are certainly very encouraging, the model presented is not expected to become a panacea for equity investment decision-making. Instead, the intent of the paper is to emphasize that the model demonstrates the potential for improving investment decisions by combining objective with subjective investment criteria. A related point the author would like to stress is the desirability of using objective models to test, over a large sample of companies for several time periods, the actual investment results associated with quantifiable, subjective investment criteria; it is in this vein that the major contribution of the paper lies.

FOOTNOTES

¹The .84 probability results from the .68 probability that the PE ratio will fall within one standard deviation of the mean. Since we are only concerned with the PE falling below the mean, the probability of it falling one standard deviation below the mean is .16, and the probability of it having a value greater than one standard deviation below the mean is $1.0 - .16 = .84$. The same reasoning holds for the two standard deviation example.

²The EPS growth rates are calculated as the arithmetic mean of the annual percentage changes in the primary EPS excluding extraordinary items. The reason for using arithmetic means of percentage changes is twofold. First, the small number of observations resulted in an unreasonably large standard error for using a log-linear regression model and second, the use of the arithmetic mean instead of the geometric mean or internal rate of return permitted the use of the standard deviation as a measure of the stability of the EPS growth rate.

³In this paper, "ex ante" refers to the period during which the distributions of EPS growth rates (annual percentage changes in EPS) and PE ratios are estimated using historical data. The "ex post" period refers to the period used to evaluate the returns of the stocks selected at the end of each annually-updated "ex ante" period.

⁴Actually, for the four year "ex ante" periods, five annual EPS values were used to obtain four annual percentage changes in the EPS, while the high and low PE ratios were determined by using the high and low stock prices in one year divided by the EPS for the subsequent year to produce four high, low, and average PE ratios for each ex ante period. The use of longer ex ante periods might have improved the performance of the LC portfolios; however, since the Compustat Annual Industrial Tape has only 20 years of data, this would have decreased the number of post evaluation periods for demonstrating the performance of the model.

⁵The EPS value in the "current PE ratio" is increased by the average annual EPS growth rate, $\bar{g}_{EPS}$, in order to calculate a current PE ratio which is comparable to the PE ratios used in determining the "lowest probable PE ratio" in which the past year's price is compared to the next year's EPS.

⁶The range of a random variable divided by 6 is a reasonable approximation of the standard deviation. This approximation was employed in order to use both the high and low stock prices instead of the annual closing price. This procedure uses more of the available information in determining the dispersion of the PE ratio distribution.

⁷A sensitivity analysis was used in order to examine the effects of changing the CV and PERAC parameters upon the portfolio returns.

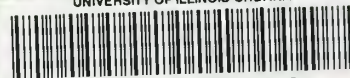
⁸That is, using this technique assumes the optimal parameters were known for use at the end of the first ex ante period, when, in fact, the optimal parameters for the entire period were not known until the end of the last ex post period.

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